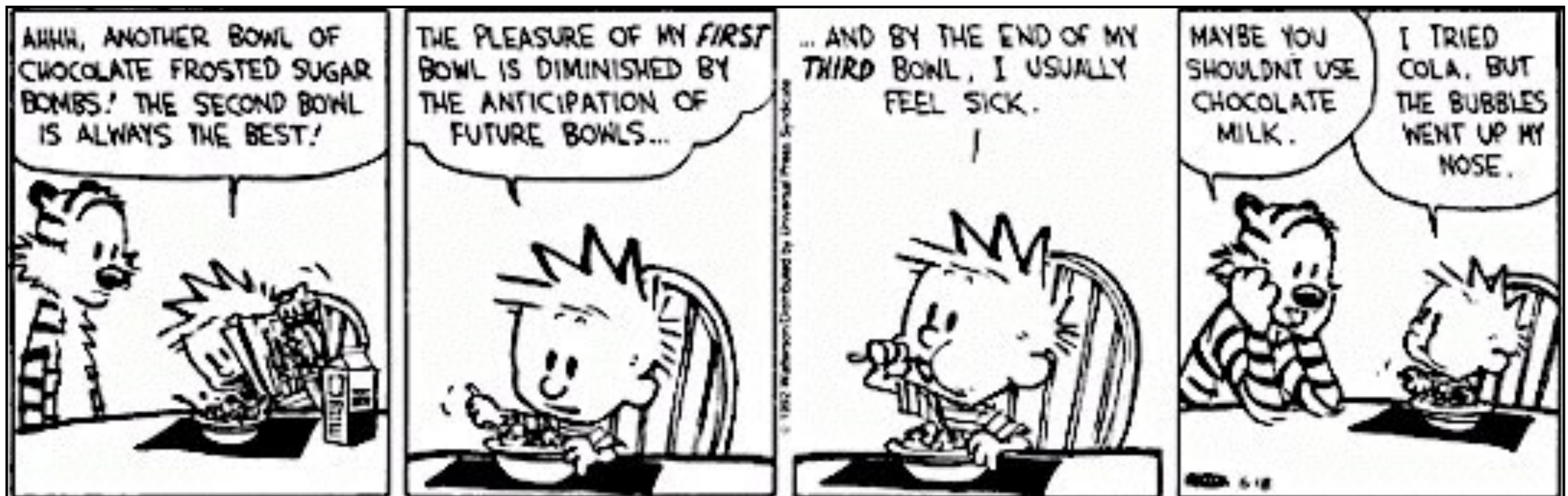


# Calculating Marginal...

Chen Wen, Hannah, Jenny



- In economics, marginal always means "**extra**"

# Marginal Product (MP)

- The extra output that is produced by using an extra unit of the variable factor
- $MP = (\Delta TP) / (\Delta V)$ , where  $\Delta TP$  is the change in total output and  $\Delta V$  is the change in the number of units of the variable factor employed.

$$MP = \Delta TP / \Delta V =$$

$$(45-25)/(3-2) =$$

$$20/1 = 20$$

1	2	3	4
Quantity of labour (V)	Total product (TP)	Average product (AP)	Marginal product (MP)
0	0		
1	10	10	10
2	25	12.5	15
3	45	15	20
4	70	17.5	25
5	90	18	20
6	105	17.5	15
7	115	16.43	10
8	120	15	5

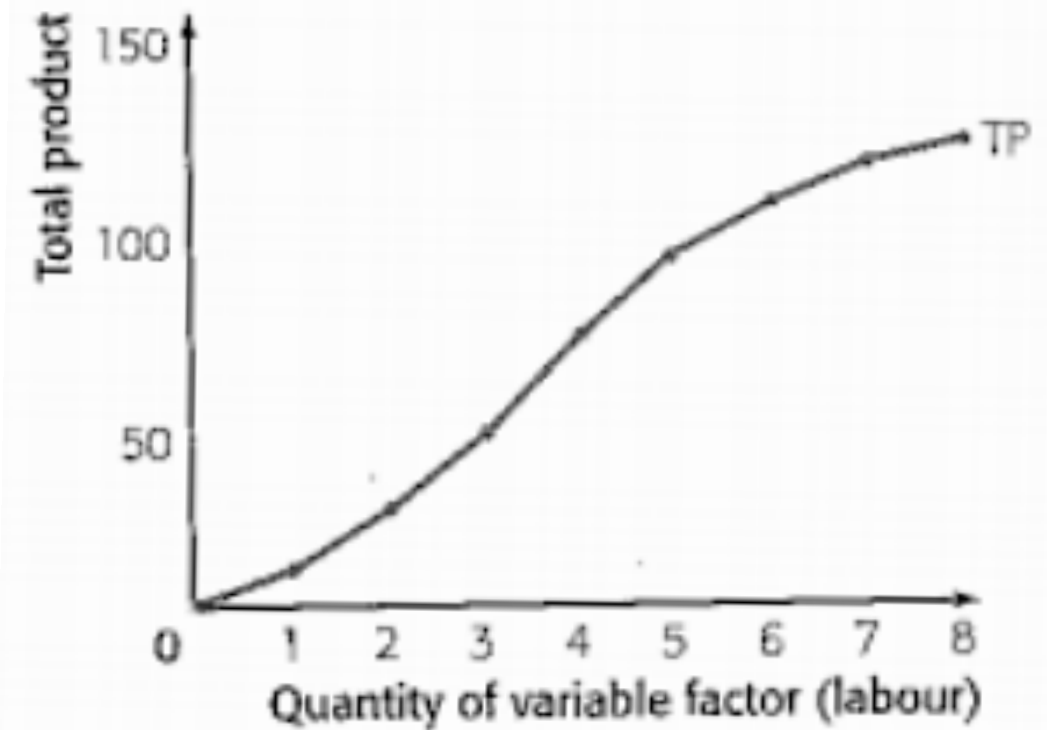


Figure 6.1 The total product curve

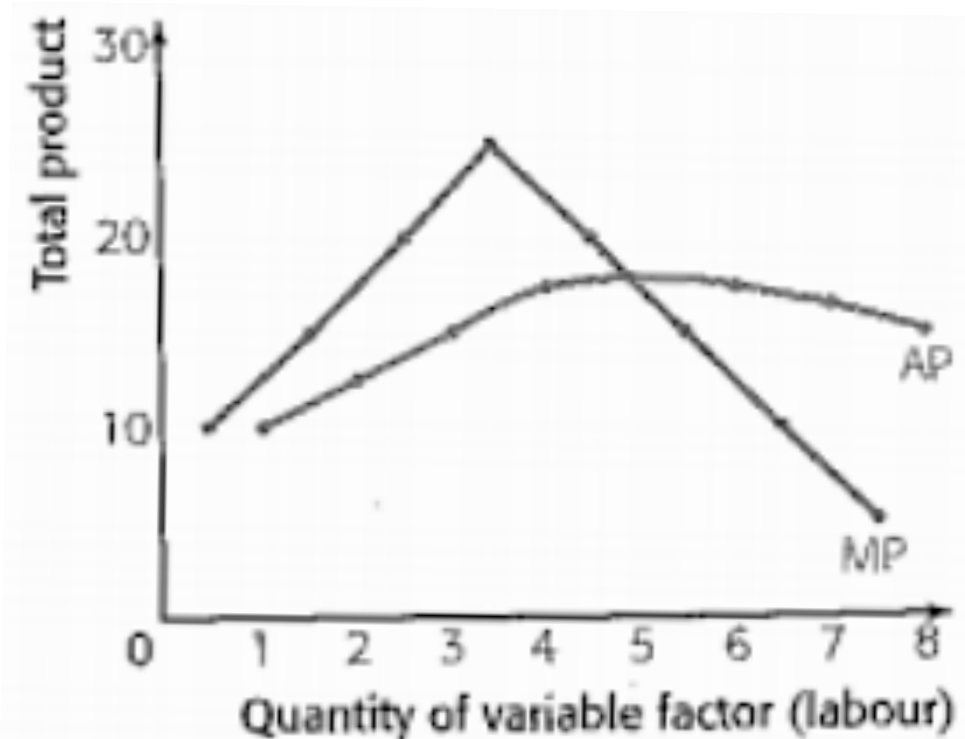
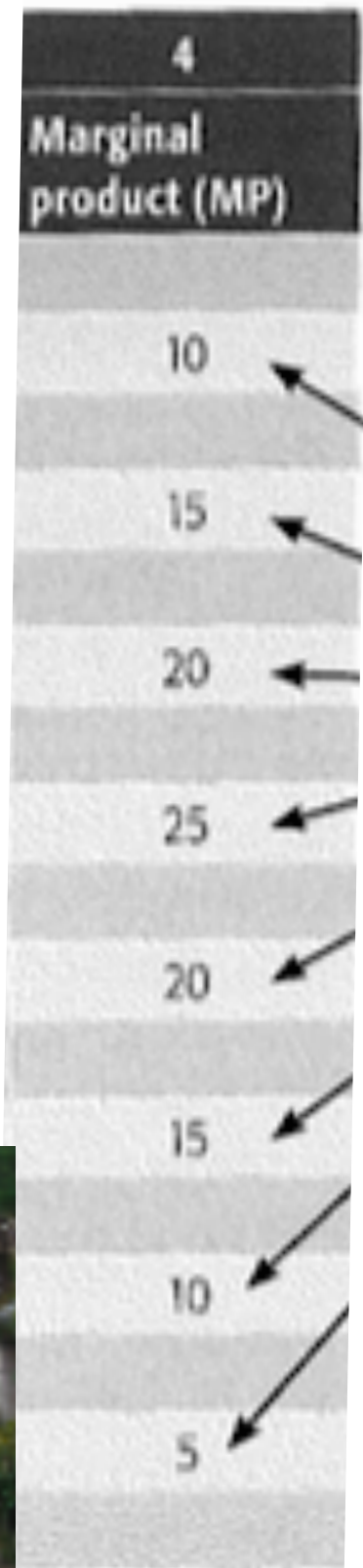
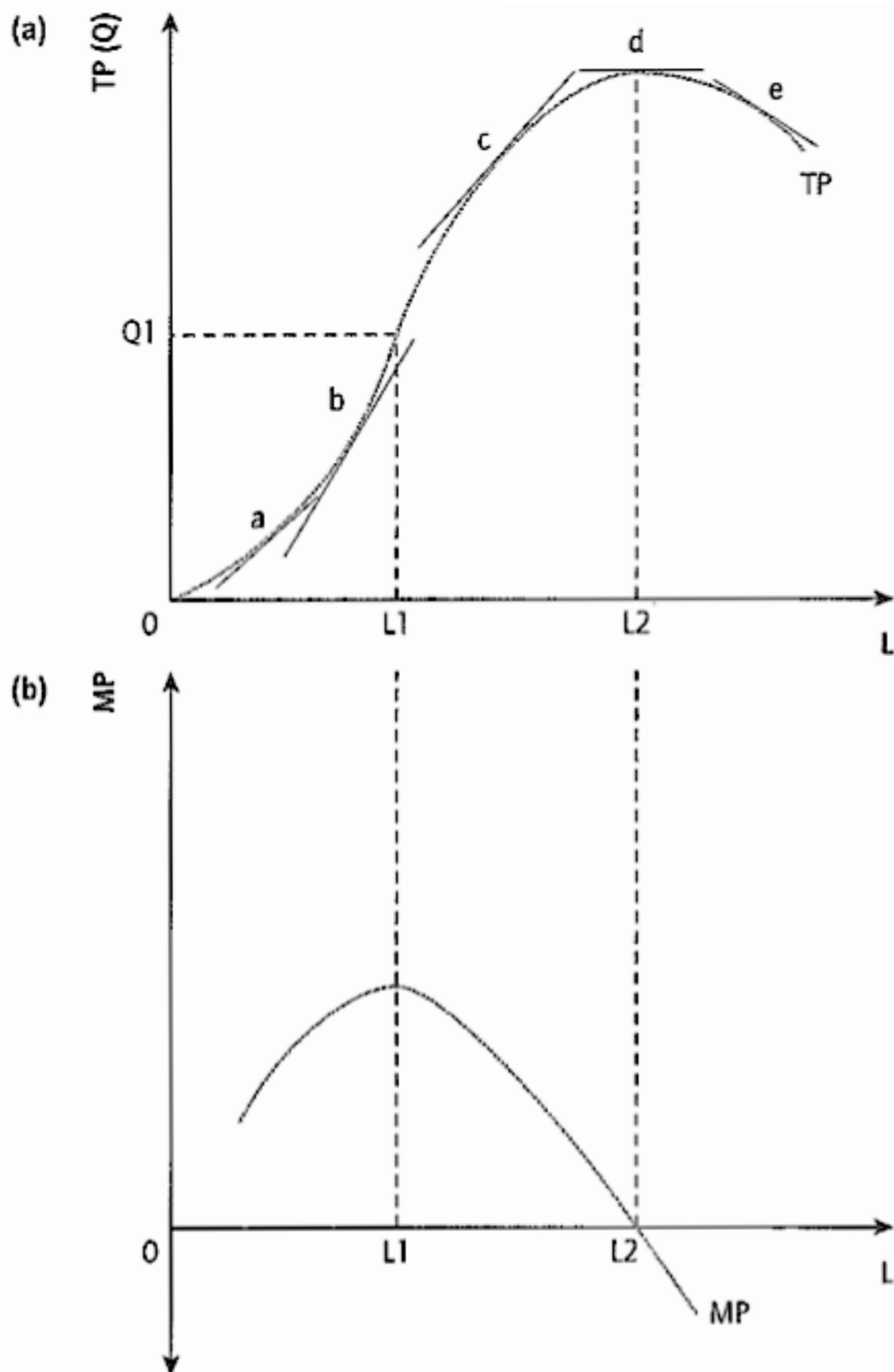


Figure 6.2 Average and marginal product curves

# Related to...

- **Law of Diminishing Marginal Returns:** As extra units of a variable factor are added to a given quantity of a fixed factor, the output from each additional unit of the variable factor will eventually diminish.
- Ex. In Mr. Izzy's burger shop, it was effective to add extra people, but only up to 3, but due to the fixed space of the shop it became less efficient with more people, couldn't increase output of burgers by as great an amount as before
  - Inefficiency began to occur





**Figure 1.5.1** Total product, marginal product and the law of diminishing marginal returns

This is the **relationship between MP and TP**.

- Output is initially increasing at an increasing rate until  $L1$
- Marginal product is the slope of total product
- MP is also rising up until  $L1$
- Now, adding workers will help increase TP, but at a slower rate until  $L2$
- MP is positive but decreasing between  $L1$  and  $L2$
- After  $L2$ , TP decreases because labor is too much for the capital available.
- MP is negative.

This is the **relationship between MP and AP.**

- If marginal  $>$  average then average will rise.
- If marginal  $<$  average then average will drop.
- If marginal = average then average will be a maximum.
- **Tip:** Think of “marginal” as a test grade and “average” as your overall grade in a class!

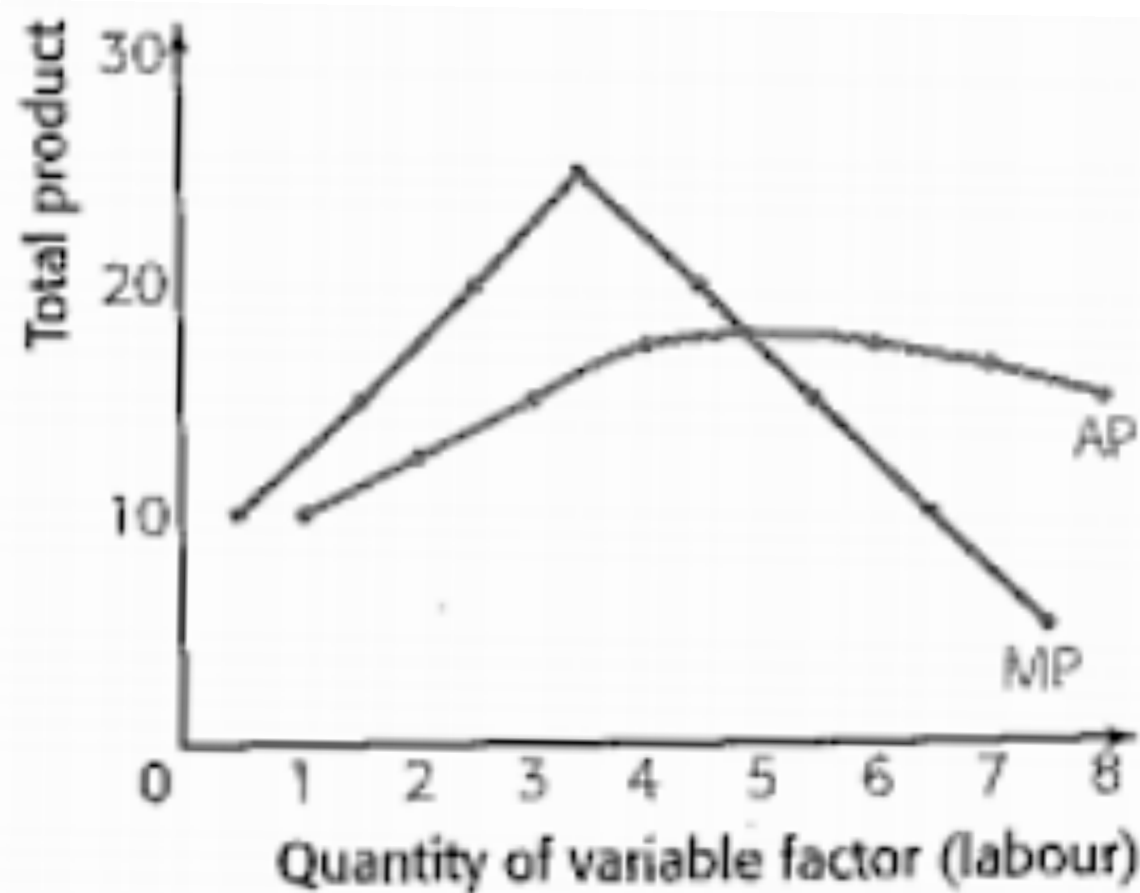
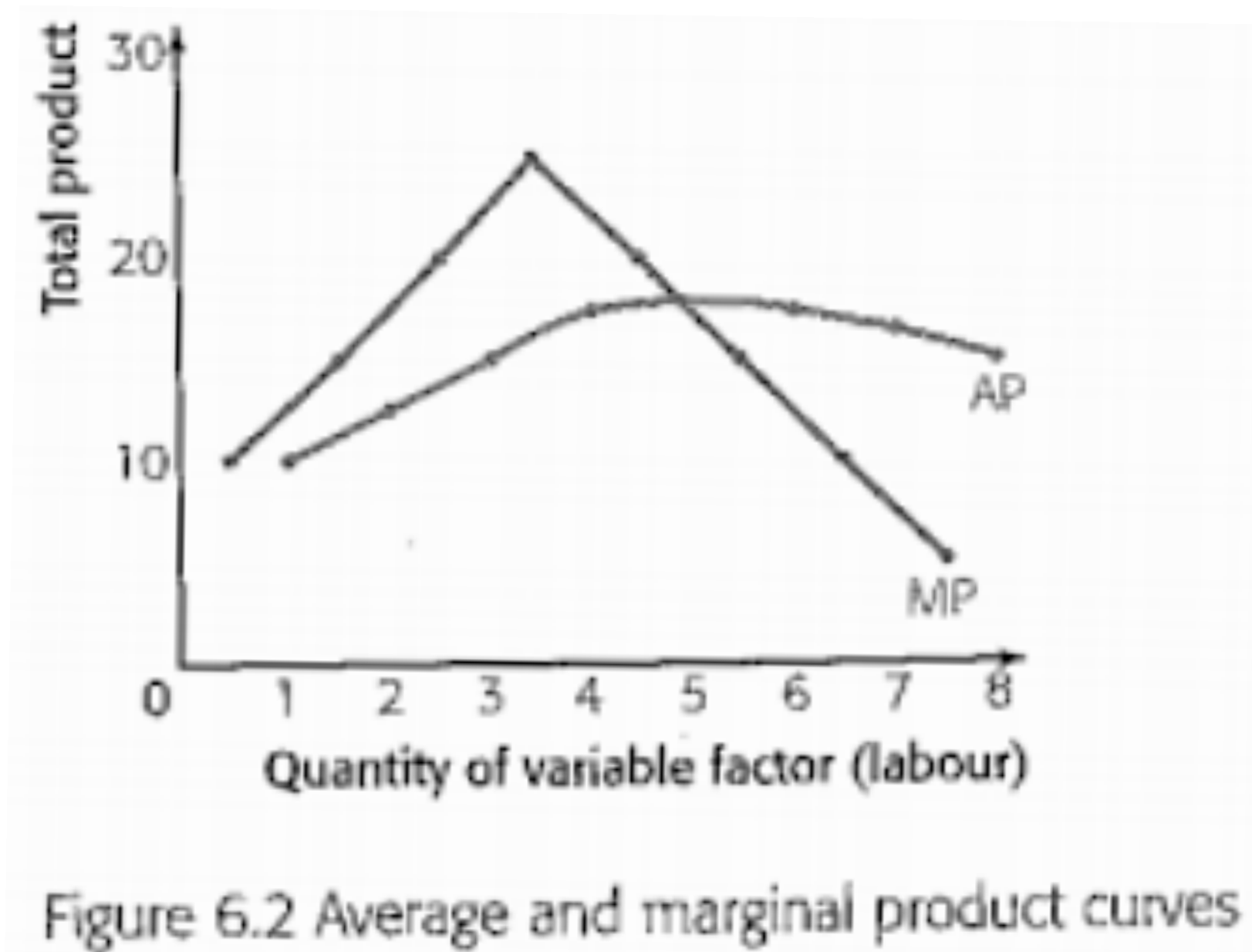


Figure 6.2 Average and marginal product curves



- $L'$  is the point beyond which AP of labor decreases.
- MP cuts AP at its maximum point
- To the left of  $L'$ ,  $MP > AP$ , so AP is rising.
- To the right of  $L'$ ,  $MP < AP$ , so AP is decreasing.
- $L'$  AP will be at a maximum.





# Marginal Cost (MC)

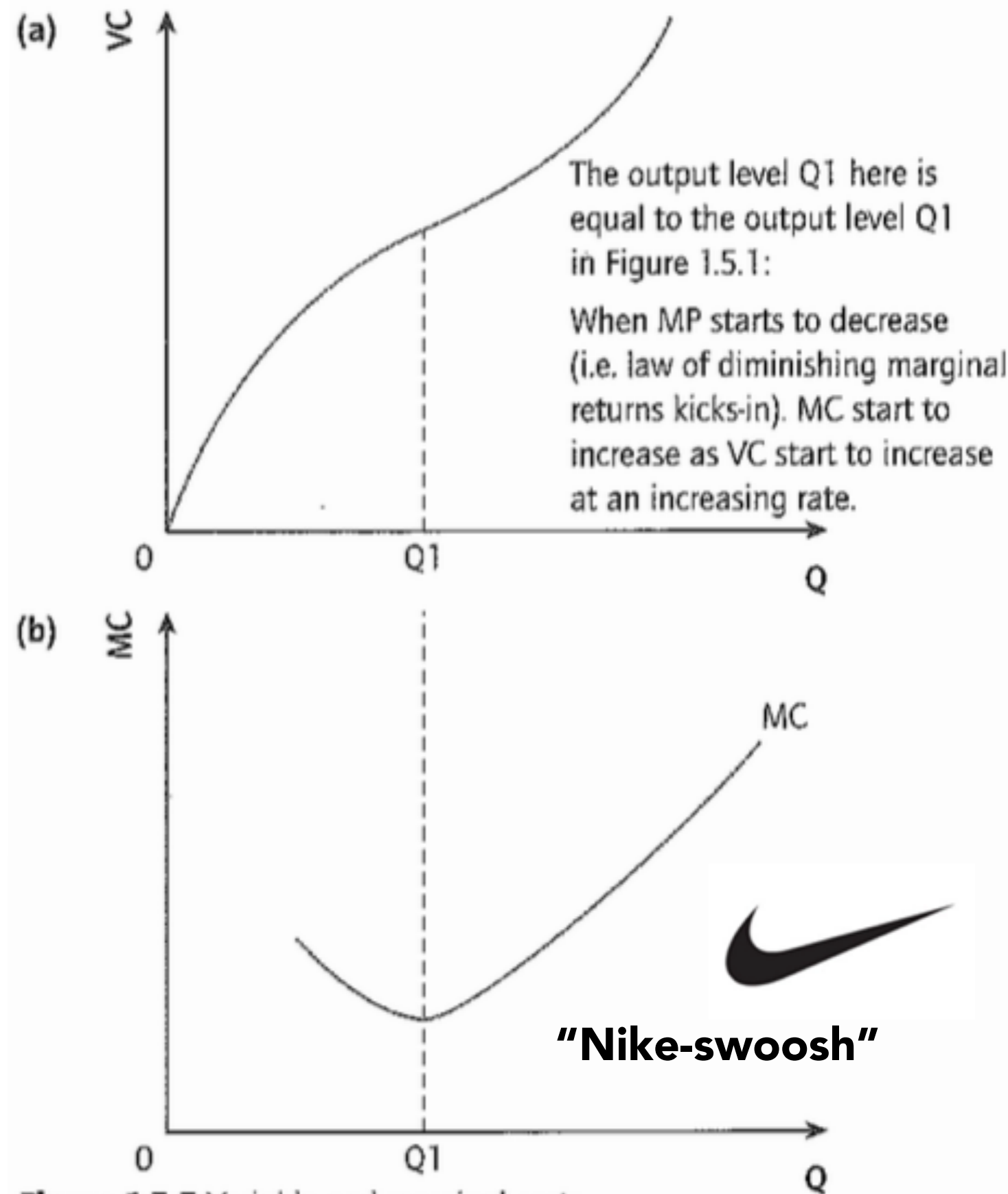
- The increase in total cost of producing an extra unit of output.
- $MC = (\Delta TC)/(\Delta Q)$ , where  $\Delta TC$  is the change in costs and  $\Delta Q$  is the change in the level of output.

1	2	3	4	5	6	7	8	9
Quantity of labour (V)	Total product (TP) or Output (q)	Total fixed cost (TFC)	Total variable cost (TVC)	Total cost (TC)	Average fixed cost (AFC)	Average variable cost (AVC)	Average total cost (ATC)	Marginal cost (MC)
0	0	400	0	400	-	-	-	
								20
1	10	400	200	600	40	20	60	
								13.33
2	25	400	400	800	16	16	32	
								10
3	45	400	600	1,000	8.89	13.33	22.22	
								8
4	70	400	800	1,200	5.71	11.43	17.14	
								10
5	90	400	1,000	1,400	4.44	11.11	15.55	
								13.33
6	105	400	1,200	1,600	3.81	11.43	15.24	
								20
7	115	400	1,400	1,800	3.48	12.17	15.65	
								40
8	120	400	1,600	2,000	3.33	13.33	16.67	

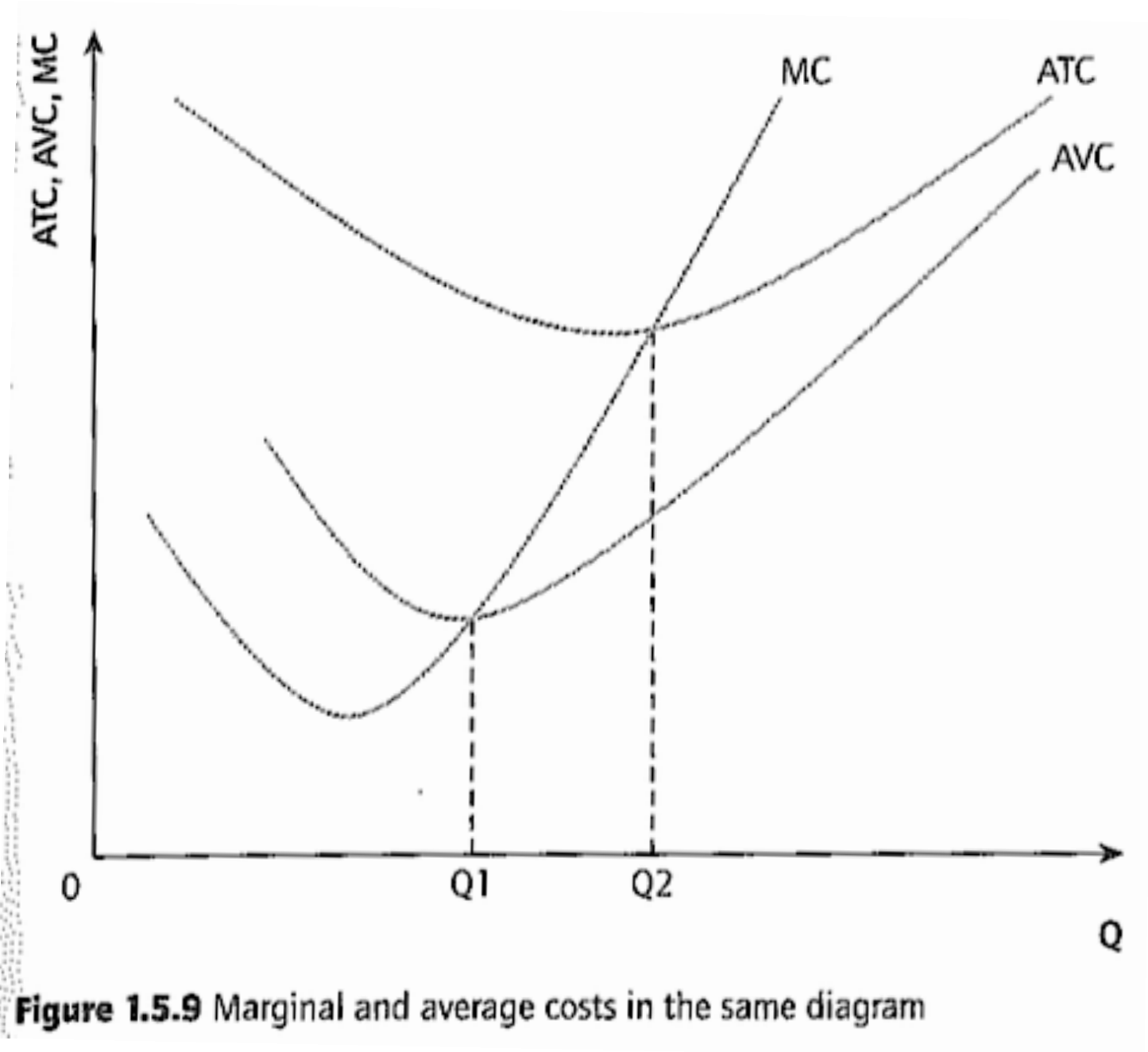
Table 6.2 Total, average, and marginal costs per week

$$MC = \Delta TC / \Delta Q = (1000-800)/(45-25) = 200/20 = 10$$

- Marginal cost is the slope of the Variable Cost (VC)
- As more is produced, VC rises but at a decreasing rate until  $Q_1$
- It is easier to produce more output with more units of labor initially
- MC initially decreases until  $Q_1$
- Diminishing marginal returns happen. Beyond  $Q_1$ , VC rises at an increasing rate.
- MC increases after  $Q_1$ .



**Figure 1.5.5** Variable and marginal costs



- If  $M < A$ ,  $A$  will drop
- If  $M > A$ ,  $A$  will rise
- If  $M = A$ ,  $A$  will be at a minimum

- MC cuts AVC and ATC at their minimum points
- If AVC decreases for all units of output to the left of  $Q_1$ , MC must lie below it.
- If AVC is rising for output to the right of  $Q_1$ , MC must lie above it.
- If ATC decreases for all units of output to the left of  $Q_2$ , MC must lie below it.
- If ATC is rising for output to the right of  $Q_2$ , MC must lie above it.

# Marginal Revenue

- The extra revenue that a firm gains when it sells one more unit of a product in a given time period.
- $MR = (\Delta TR)/(\Delta Q)$  , where  $\Delta TR$  is the change in total revenue and  $\Delta Q$  is the change in the quantity of the good/service sold in the time period being considered.



# 1. Revenue when price does not change with output (elasticity of demand is infinite)

Price (\$)	Quantity demanded	Total revenue (\$)	Average revenue (\$)	Marginal revenue (\$)
5	1	5	5	5
5	2	10	5	5
5	3	15	5	5
5	4	20	5	5
5	5	25	5	5
5	6	30	5	5
5	7	35	5	5

Table 6.3 Possible revenue figures for a firm with a perfectly elastic demand curve

- MR from selling an extra unit will equal to P.
- MR will be a straight line, identical to the demand curve and AR.

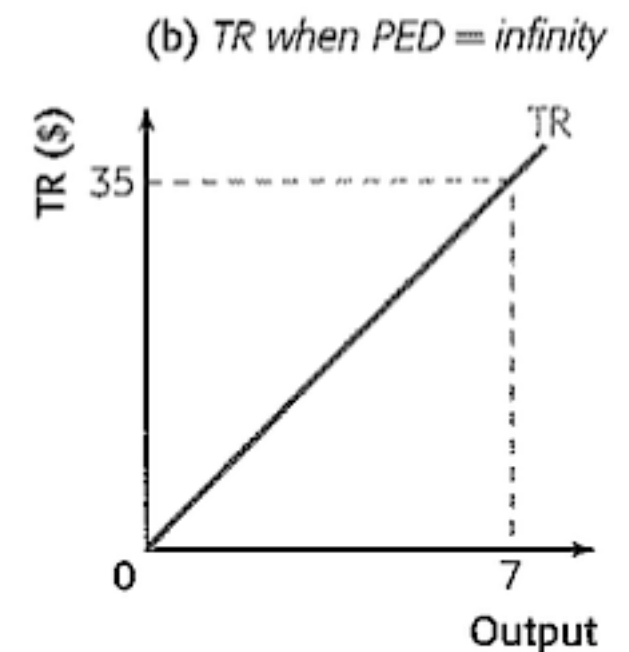
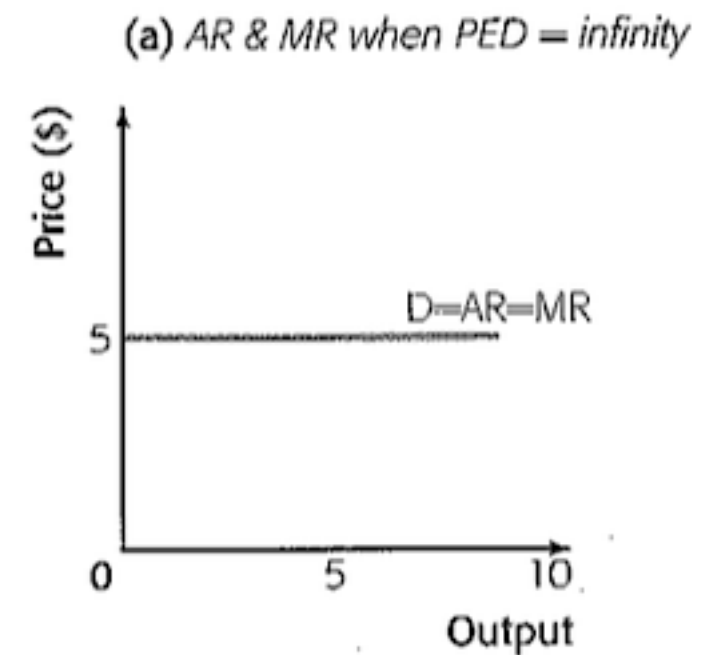


Figure 6.9 Curves for  $PED = \text{infinity}$

## 2. Revenue when price falls as output increases (demand curve is downward sloping, elasticity of demand falls as output increases)

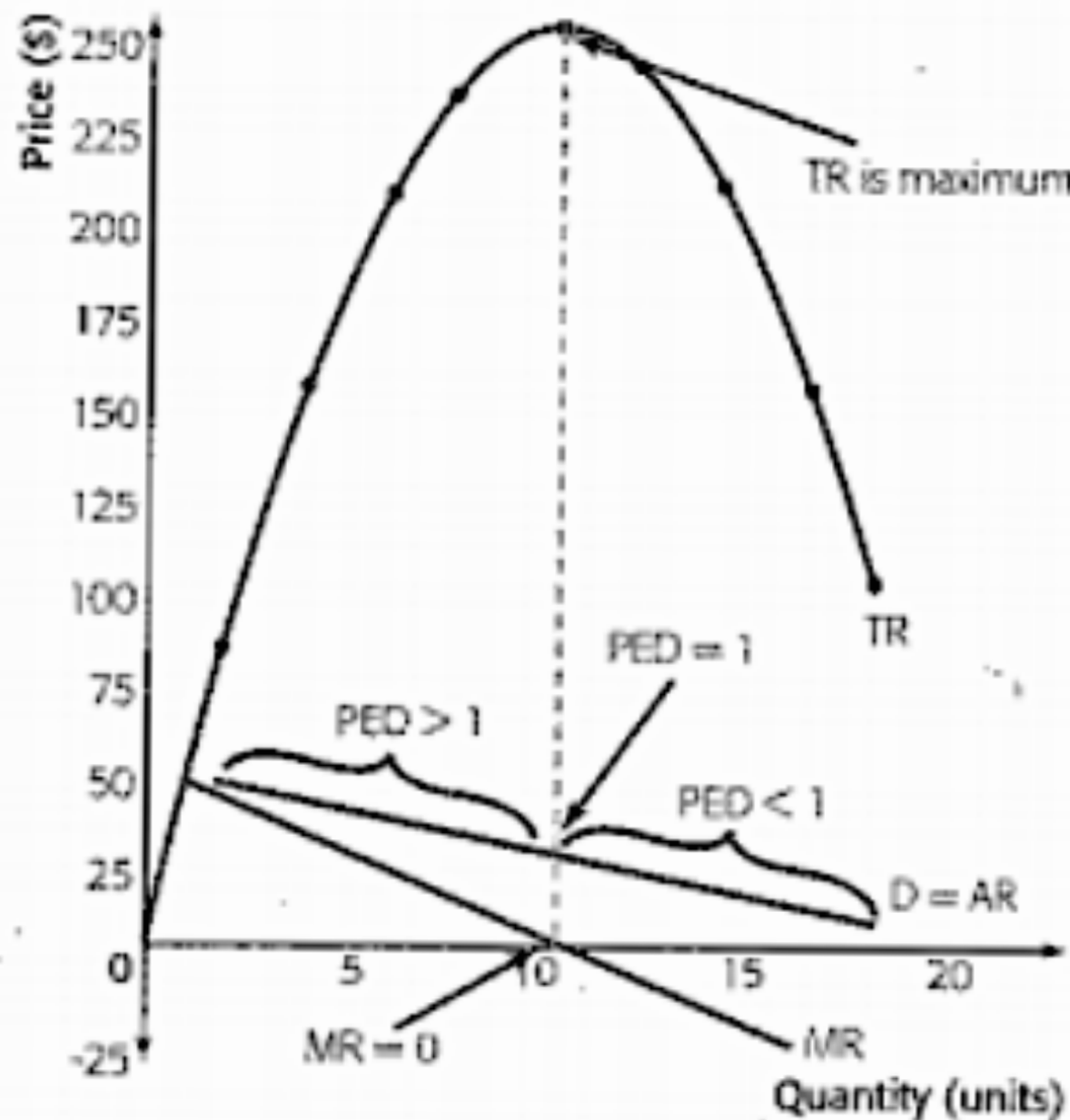


Figure 6.10 The relationship between D, AR, MR, TR, and PED for a normal demand curve

- Since AR continuously decreases, MR must be less than AR
- The negative MR means that TR will fall



# Example:

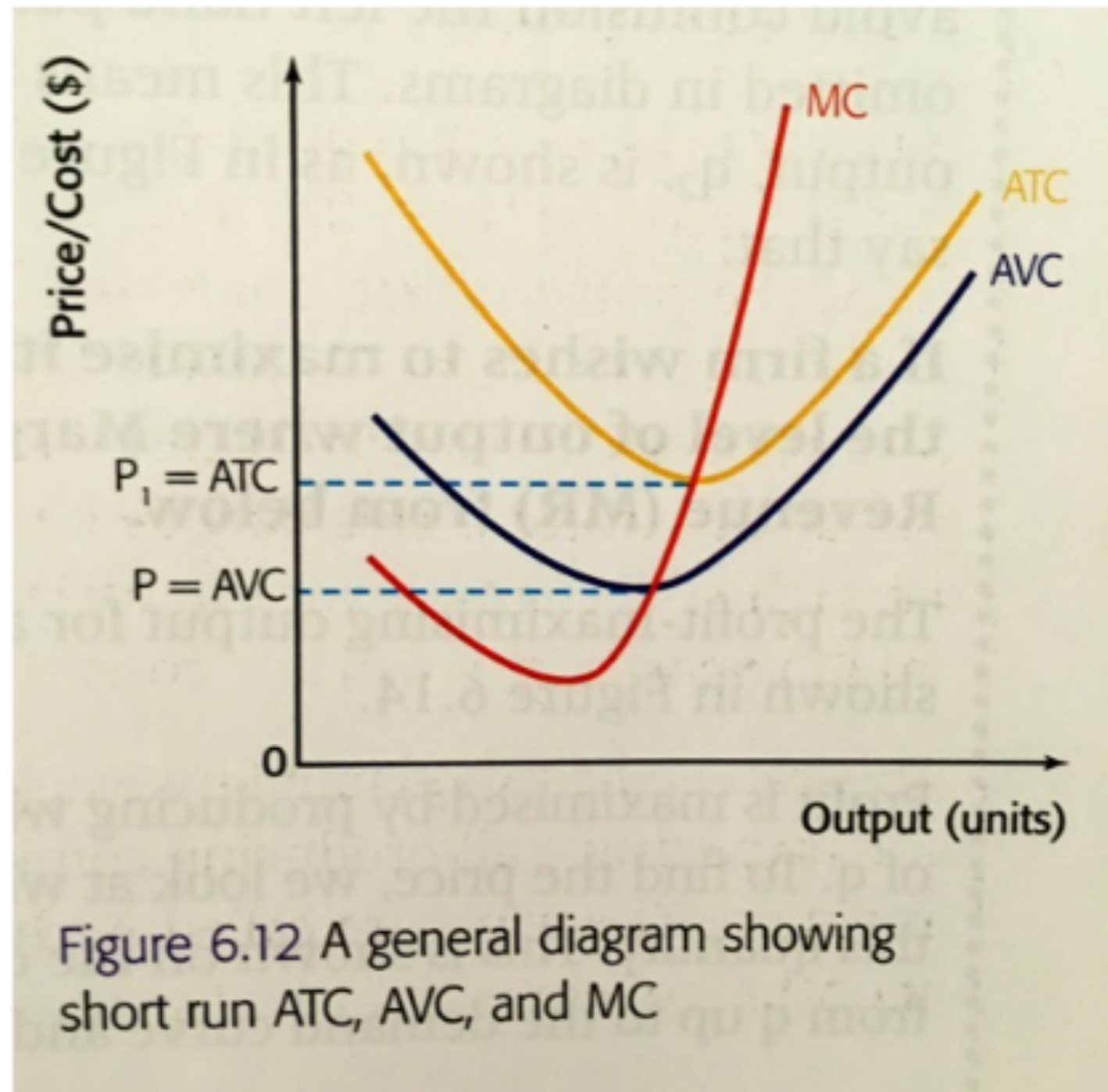
Price (\$)	Quantity demanded	Total revenue (\$)	Average revenue (\$)	Marginal revenue (\$)	PED
50	0	0			
				45	
45	2	90	45		9.00
				35	
40	4	160	40		4.00
				25	
35	6	210	35		2.33
				15	
30	8	240	30		1.50
				5	
25	10	250	25		1.00

Table 6.4 Output, revenue and PED figures for a company with a normal demand curve

- Price drops from \$40 to \$35
- Qd increases from 4 to 6
- Before \$160 (40 x 4)
- Now \$210 (35 x 6)
- $210 - 160 = \$50$
- $MR = (\Delta TR / \Delta q) = 50 / 2 = \$25$

# Break-Even Price

- When a firm is able to make normal profit in the long run
- It will break even, covering all costs, even opportunity cost.
- $\text{Price} = \text{ATC}$
- Break even  $\text{Price} = P_1$ .  
 $P_1 = \text{ATC}$ , so all cost are covered





# The Profit-Maximizing level of output

- The firm needs to know what level of output they have to produce in order to achieve maximum profits
- $MR > MC$  = Increase Production
- (a) shows  $MC=MR$  Profit minimization. Firm has made a loss on every unit when  $MC > MR$ .  $q_1$  to  $q_2$  makes profit because  $MR > MC$
- **If a firm wants to maximize profits, it should produce at a level of output where MC cuts MR from below.**

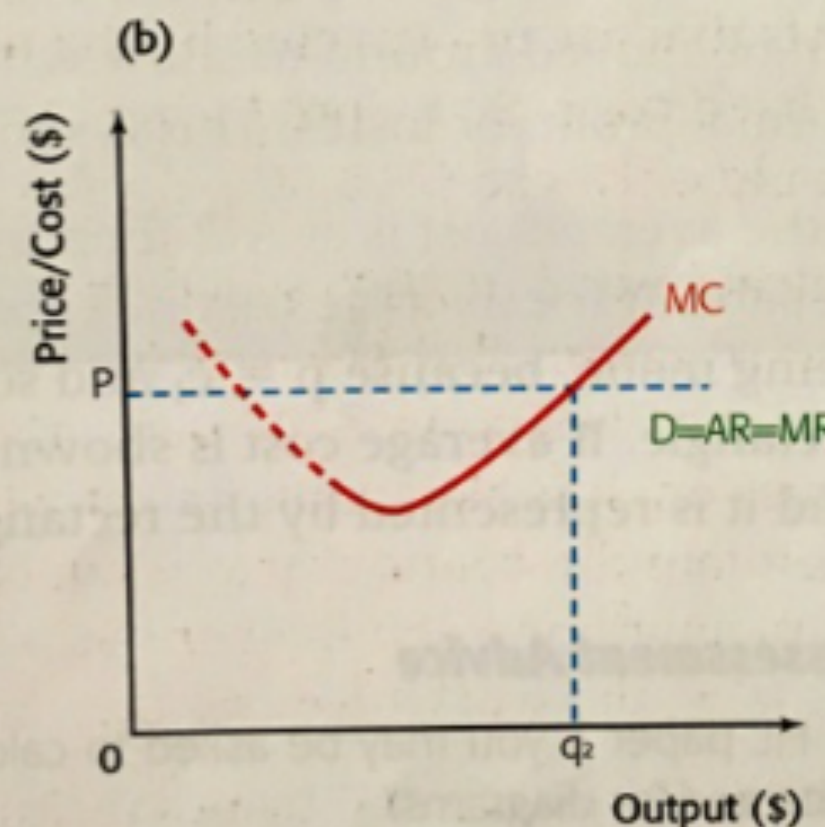
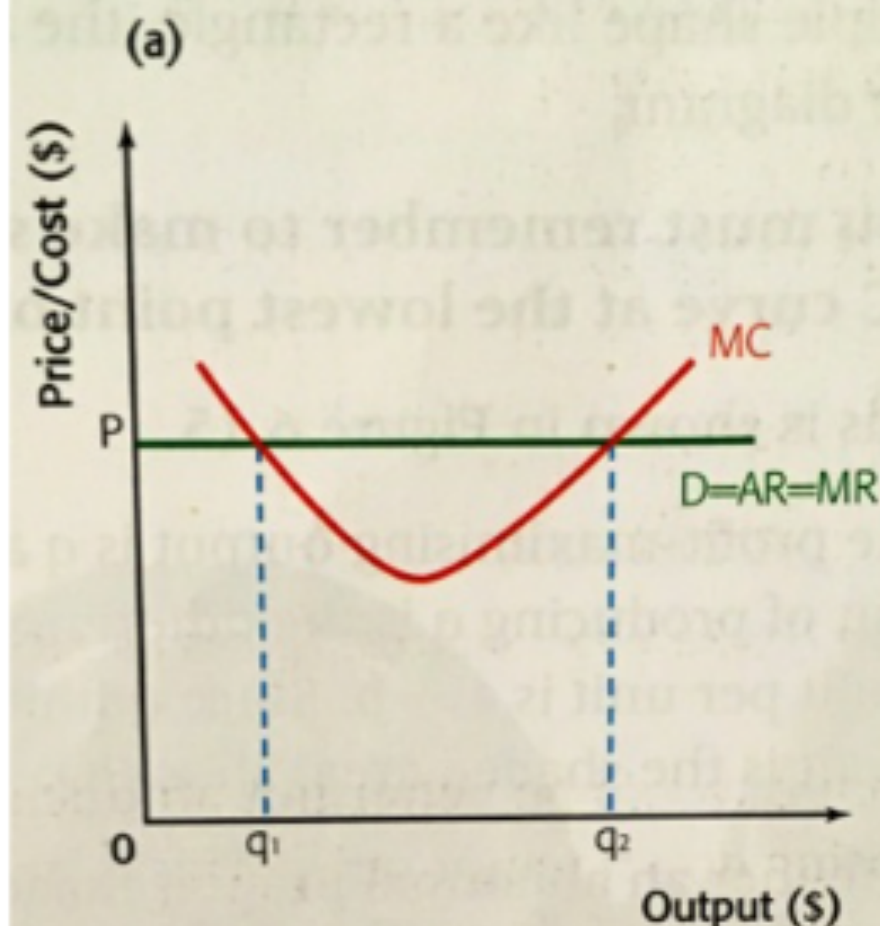


Figure 6.13 Revenue and costs for a firm with a perfectly elastic demand curve

# Cont.

- Profit is maximized when  $MC=MR$ .
- At Fig 6.14, To find the price, we look at what consumers are willing to pay for this quantity (q to p)
- **MC curve cuts AC curve at lowest point on AC**
- Profit-maximizing output is q and price is p. The profit per unit of producing q is  $AR-AC$  (a-b). q units are produced, the total abnormal profits =  $ab \times OQ$

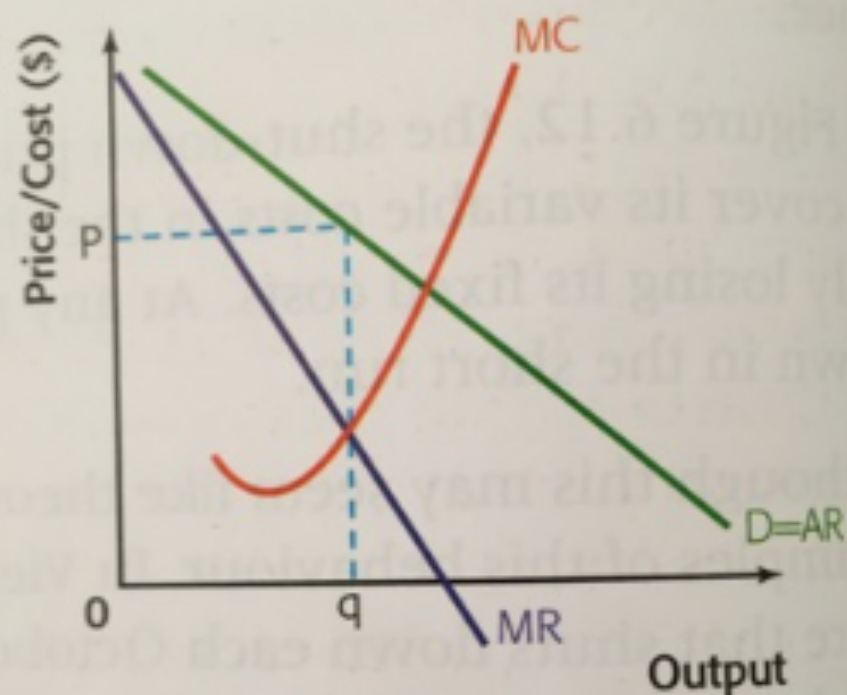


Figure 6.14 The profit-maximising level of output for a normal demand curve

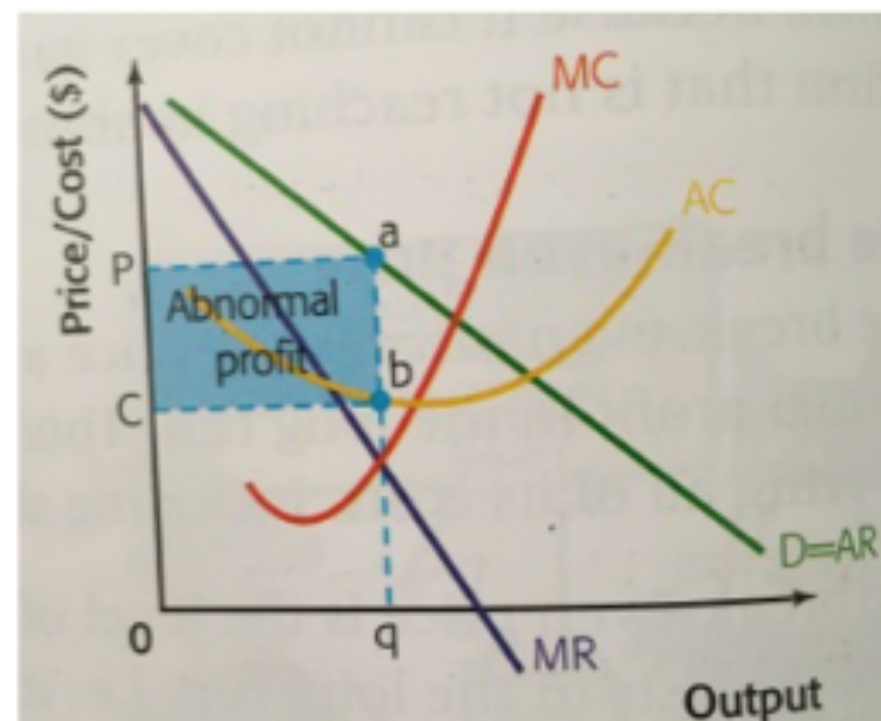
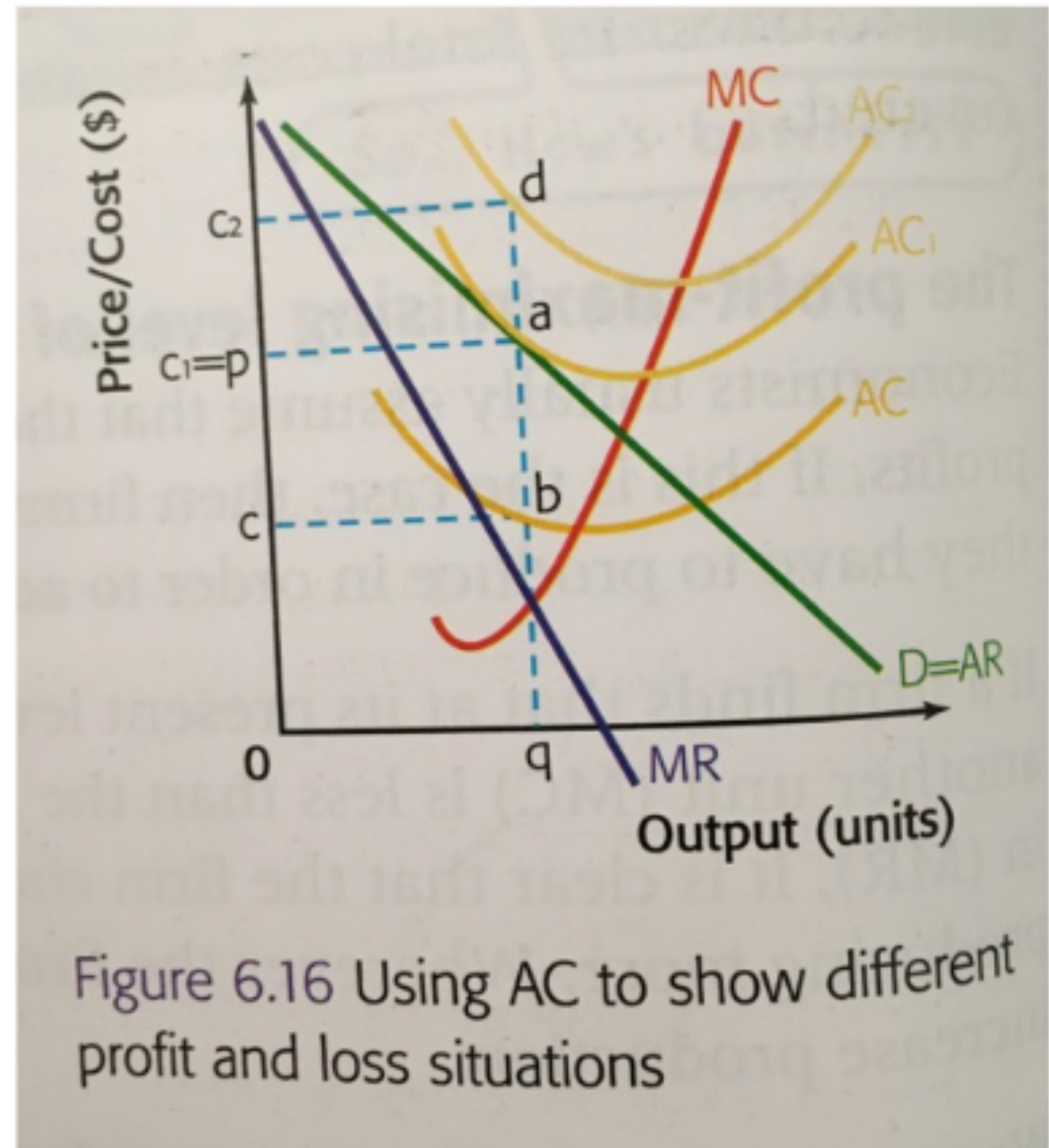


Figure 6.15 Showing an area of profit using the AC curve



# Cont.

- Tip: AC curve is a student's best friend because it abnormal profit is made!
- It can be moved around
- Fig 6.16, AC1=normal profit because  $p=c1$
- AC2=loss



# Marginal Tax Rate (MTR)

- The extra tax paid as a result of extra income earned
- $MTR = \Delta T / \Delta Y$  = change in total tax paid / change in income

## Paper 3 Example:

Income (\$)	%
0 - 5000	0
5001 - 20000	20
20001 - 40000	40
40001 +	50

Individual A (low income) earns  
\$15000/year

Individual B (middle income) earns  
\$38000/year

Individual C (high income) earns  
\$90000/year

**If individual B receives an increase in earning from \$38000 to \$48000, what will be the marginal tax rate?**

marginal tax rate = (change in total tax paid / change in income) \* 100

Individual B now pays  $(\$5000 * 0\%) + (\$15000 * 20\%) + (\$20000 * 40\%) + (\$8000 * 50\%) = \$15000$

- Earns \$10000 more (\$38000 to \$48000)
- Pays \$4800 more tax (\$10200 to \$15000)

$$\text{MTR} = (\$4800 / \$10000) * 100 = 48\% \text{ of income}$$



# Related to...

Progressive Tax	Proportional Tax	Regressive Tax
ATR increases	ATR constant	ATR decreases
$MTR > ATR$	$MTR = ATR$	$MTR < ATR$
Higher income people pay proportionately more	Higher income people pay proportionately the	Higher income people pay proportionately less

